

**Quarterly Technical Report No.9  
October 20,1995**

**Reporting Period: 01 July 1994 - 30 September 1994**

**Optoelectronic Technology Consortium**

*Sponsored by:*

**Defense Advanced Research Projects Agency  
Microelectronics Technology Office**



**(PRECOMPETATIVE CONSORTIUM FOR OPTOELECTRONIC  
INTERCONNECT TECHNOLOGY)**

**ARPA Order No.8351C**

**Issued by DARPA/CMO under Contract #MDA972-92-C-0071**

**Effective Contract Date: 01 July 1992**

**Contract Expiration Date: 31 March 1995**

**Contract Amount: \$2,372,699.00**

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**OPTOELECTRONIC TECHNOLOGY CONSORTIUM**  
**Quarterly Technical Report No. 9**  
July 1 to September 30, 1994  
Honeywell, Inc.

## **1.0 Introduction.**

The Optoelectronic Technology Consortium has been established to position U.S. industry as the world leader in optical interconnect technology by developing, fabricating, integrating and demonstrating the producibility of optoelectronic components for high-density/high-data-rate processors and accelerating the insertion of this technology into military and commercial applications. This objective will be accomplished by a program focused in three areas.

**Demonstrated performance:** OETC will demonstrate an aggregate data transfer rate of 16 Gb/s between single transmitter and receiver packages.

**Accelerated development:** By collaborating during the precompetitive technology development stage, OETC will advance the development of optical components and produce links for a multiboard processor testbed demonstration.

**Producibility:** OETC's technology will achieve this performance by using components that are affordable, and reliable, with a line BER <  $10^{-15}$  and MTTF >  $10^6$  hours.

Under the OETC program Honeywell will develop packaged AlGaAs arrays of waveguide modulators and polymer based, high density, parallel optical backplane technology compatible with low-cost manufacturability. The scope of the program has been modified, such that the number of packaged waveguide modulator arrays to be fabricated under the program will be reduced, and efforts are initiated in the development of Vertical Cavity Surface Emitting Lasers.

The packaged AlGaAs modulator arrays will consist of a single fiber input, a 1x4 fanout circuit, four waveguide modulators, and four fiber outputs, all mounted on a ceramic header. The primary benefits to this approach are enhanced system reliability, particularly at high temperatures, and a device design that is highly producible due to the inherent process tolerance. Combined with the demonstrated high density of these devices when fabricated in arrays, this allows the development of compact and reliable transmitter components.

The objective of the polyimide backplane development effort is to demonstrate a practical high density (>20 lines or channels per mm) parallel optical backplane facilitating (bandwidth x length/power) interconnect figures of merit between one and two orders of magnitude greater than would be attainable with state-of-the-art electrical interconnects. The effort will address both development of an ultimately manufacturable and environmentally tolerant optical backplane, and the optical interface concepts required for practical board-to-backplane optical connection. The key functionalities, and compatibility with standard multiboard assembly practices will be demonstrated in a laboratory evaluation system.

Technical progress achieved during the current reporting period, and plans for the next reporting period, are summarized in the following sections.

## 2.0 Progress Summary.

### 2.1 AlGaAs Modulator Array Development. Task leader: Dr. Mary Hibbs-Brenner

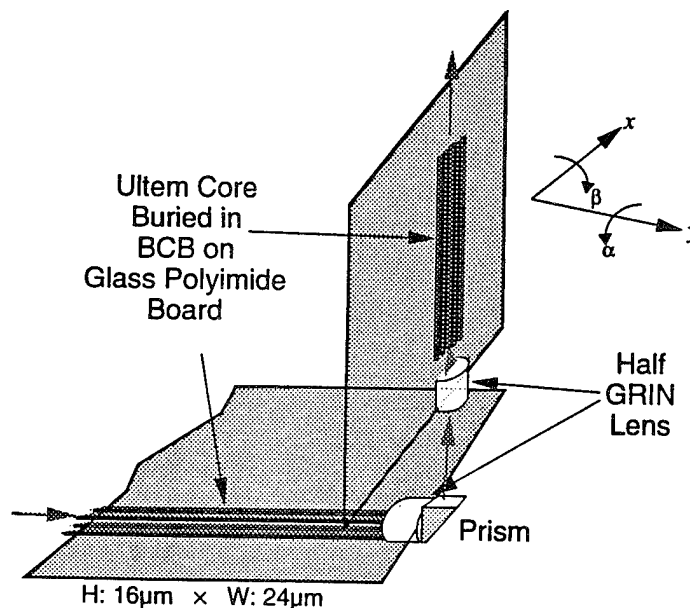
No activity during the current reporting period.

### 2.2 AlGaAs Modulator Array Packaging. Task leader: Mr. John Lehman

No activity during the current reporting period

### 2.3. Polymer Backplane Development. Task leader: Dr. Julian Bristow

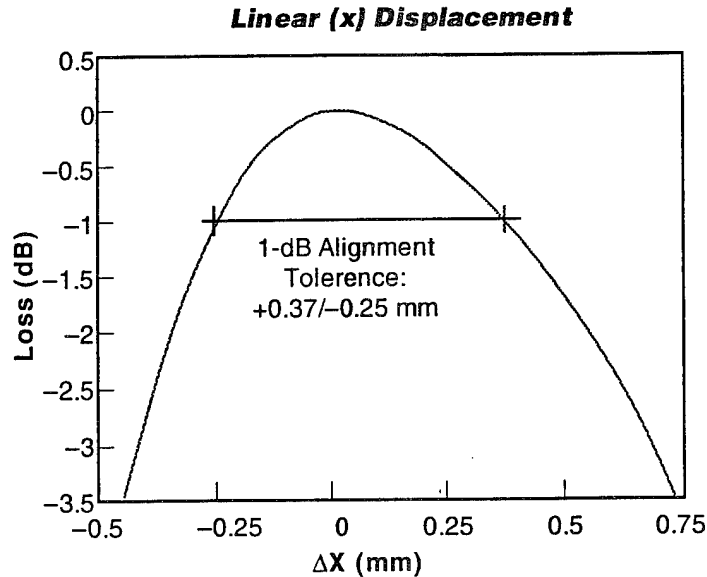
The final results from the backplane demonstration project are illustrated in Figure 1. The experiment consisted of the following components (Figure 1(a)): Polymer waveguides were fabricated on two separate boards. On each board a fixture which holds a half grin lens was located using the features etched into the same polymer layers to passively locate the fixture. The same fixture on one of the boards also held a prism used to bend the light by 90°. Each board was then mounted on stages with micropositioners, so that the tolerance to translational and rotational alignment could be measured.



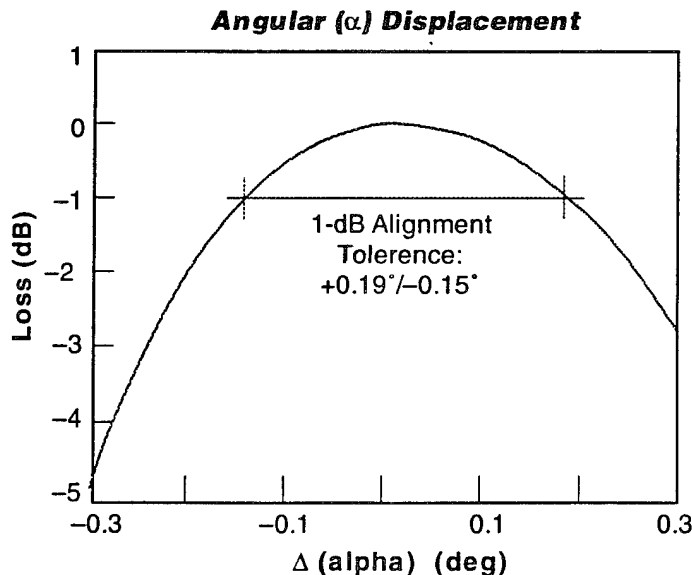
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Fig. 1: (a) Schematic of optical backplane alignment tolerance experiment

The results of this experiment are summarized in Figure 1(b) and (c). The decrease in throughput as a function of misalignment was measured. If the criteria is that misalignment contributes less than 1dB additional loss, then it was observed that the translational alignment should be maintained to within  $+0.37/-0.25$ mm. Since the tolerance should be symmetrical, the discrepancy is probably due to experimental error. When the same criteria is applied to rotational alignment, it is found that a misalignment of  $+0.19/-0.15$  deg can be tolerated. This reduced tolerance to rotational misalignment is by design. Translational tolerance is achieved at the expense of rotational tolerance, but it is expected that the latter is easier to control in the situation of plugging a daughterboard into a motherboard.



**Figure 1: (b) Tolerance to translational alignment**



**Figure 1: (c) Tolerance to rotational alignment**

Other measured results from this demonstration include a waveguide propagation loss of 0.3dB/cm and a connector loss of 3.4dB. A previously measured result indicated that 36 channels could be coupled from one board to the other within the space of a connector based upon a 3mm grin lens with  $<20$ dB optical crosstalk.

**2.4 Vertical Cavity Surface Emitting Laser Development. Task leader: Dr. Mary Hibbs-Brenner**

No activity during the current reporting period.

**3.0. Fourth quarter plans.**

**3.1. AlGaAs Modulator Array Development.**

The modulator array development task is essentially complete.

**3.2. AlGaAs Modulator Array Packaging.**

The modulator array packaging task is essentially complete.

**3.3. Polymer Backplane Development.**

The polymer backplane development task is essentially complete.

**3.4. Vertical Cavity Surface Emitting Laser Development.**

This effort will be continued under the OETC-2 program. No further development will take place under the current program.

**4.0. Summary.**

During this reporting period the effort was concentrated on carrying an experiment on measuring the coupling efficiency and tolerances involved in transferring data from board to board via polymer waveguides on the boards and an expanded beam connector between the boards. Waveguide propagation loss was measured as 0.3dB/cm, and the connector loss was 3.4 dB. Translational tolerance was measured as +0.37/-0.25mm, while rotational tolerance was measured to be +0.19/-0.15 deg. These results all appear to be within a practical level and consistent with tolerances achievable between a motherboard and daughterboards.